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MACTEC ENVIRONMENTAL RESTORATION SERVICES, LLC

Spectral Gamma-Ray Borehole
Log Data Report

Log Event A

Borehole 10-04-12

Borehole Information

Farm : A	**Tank :** A-104	**Site Number :** 299-E24-69
N-Coord : 41,355	**W-Coord :** 47,815	**TOC Elevation :** 688.32
Water Level, ft :	**Date Drilled :** 5/31/1962	

Casing Record

Type : Steel-welded	Thickness, in. : 0.280	ID, in. : 6
Top Depth, ft. : 0	Bottom Depth, ft. : 73	

Borehole Notes:

This borehole was drilled in May 1962 and completed to a depth of 75 ft. A driller's log for this borehole was not available. There is no indication in Chamness and Merz (1993) that the casing was perforated or grouted. Chamness and Merz (1993) state the borehole was deepened to 125 ft, but there is no supporting documentation. The logging engineers report the borehole is 72.5 ft deep with 6-in.-diameter casing. It is unlikely that this borehole was ever deepened as reported.

For this report, a 6-in.-diameter casing was used to process the SGLS data. It is assumed the casing thickness is 0.280 in., on the basis of the published thickness for schedule-40, 6-in. pipe, as observed by the logging engineer.

The top of the casing is the zero depth reference for the SGLS. The casing lip is even with the ground surface.

Equipment Information

Logging System : 2	**Detector Type :** HPGe	**Detector Efficiency:** 35.0 %
Calibration Date : 05/1996	**Calibration Reference :** GJPO-HAN-5	**Logging Procedure :** P-GJPO-1783

Logging Information

Log Run Number :	1	**Log Run Date :**	09/19/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	0.0	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	10.5	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	2	**Log Run Date :**	09/20/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	72.5	**Counting Time, sec.:**	100	**L/R :** L **Shield :**	N
Finish Depth, ft. :	45.5	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Event A

Borehole 10-04-12

Log Run Number :	3	**Log Run Date :**	09/25/1996	**Logging Engineer:**	Bob Spatz
Start Depth, ft.:	46.5	**Counting Time, sec.:**	100	**L/R :** L	**Shield :** N
Finish Depth, ft. :	9.5	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Logging Operation Notes:

This borehole was logged in three log runs. Log run two was aborted because of concerns about borehole temperature. When logging was resumed, the overlap interval was miscalculated and the interval from 46.5 to 50.5 ft was not logged. The total logging depth achieved by the SGLS was 72.5 ft.

Analysis Information

Analyst : R.R.Spatz

Data Processing Reference : MAC-VZCP 1.7.9 Analysis Date : 03/24/1998

Analysis Notes :

The pre- and post-survey field verification spectra for all logging runs met the acceptance criteria established for peak shape and system efficiency. The energy calibration and peak-shape calibration from these spectra were used to establish the peak resolution and channel-to-energy parameters used in processing the spectra acquired during the logging operation.

A casing correction factor for 0.280-in.-thick casing was applied to the log data during the analysis process.

Shape factor analysis was applied to the SGLS data and provided insights into the distribution of Cs-137 contamination and into the nature of zones of elevated total count gamma-ray activity not attributable to gamma-emitting radionuclides.

Log Plot Notes:

Separate log plots show the man-made and the naturally occurring radionuclides. The natural radionuclides can be used for lithology interpretations. The headings of the plots identify the specific gamma rays used to calculate the concentrations. Uncertainty bars on the plots show the statistical uncertainties for the measurements as 95-percent confidence intervals. Open circles on the plots give the MDL. The MDL of a radionuclide represents the lowest concentration at which positive identification of a gamma-ray peak is statistically defensible.

A combination plot includes the man-made and natural radionuclides, the total gamma derived from the spectral data, and the Tank Farms gross gamma log. The gross gamma plot displays the latest available digital data. No attempt has been made to adjust the depths of the gross gamma logs to coincide with the SGLS data.

A plot of the shape factor analysis results is also included. The plot is used as an interpretive tool to help determine the radial distribution of man-made contaminants around the borehole.

Results/Interpretations:

The man-made radionuclides Cs-137, Co-60, and Eu-154 were detected around this borehole. Cs-137

Borehole 10-04-12

Log Event A

contamination was detected continuously from the ground surface to 9 ft at concentrations ranging from 0.3 to 16 pCi/g. Cs-137 contamination occurs intermittently from 9 to 15.5 ft at the MDL. Cs-137 contamination was also detected at the bottom of the logged interval from 70.5 to 72.5 ft at concentrations ranging from the MDL to 0.3 pCi/g. The maximum Cs-137 concentration for this borehole was 16 pCi/g at 1.5 ft

Co-60 contamination was detected continuously from 7.5 to 8.5 ft at concentrations ranging from 0.1 to 0.3 pCi/g. Eu-154 contamination was detected continuously from 7 to 8.5 ft at concentrations ranging from 0.5 to 1.5 pCi/g.

The K-40 concentrations decrease at 15 ft from a general background of about 13 pCi/g above this depth to about 11 pCi/g from 15 to 19 ft. Between 19 and 62 ft, the K-40 concentrations increase to about 13 pCi/g. Below 62 ft, the K-40 concentrations increase to a general background of about 17 pCi/g and remain at about this concentration to the bottom of the borehole (72.5 ft). The U-238 and Th-232 concentrations decrease slightly at 15 ft and increase below 62 ft.

The U-238 (609 keV) concentrations are obscured on the log plot from the ground surface to 2.5 ft and from 7 to 8.5 ft. An elevated Compton continuum, associated with high gamma-ray activity from Cs-137 (662 keV) causes the MDL to be greater than the measurable 609-keV activity.

The interval from 46.5 to 50.5 ft was not logged because of an overlap miscalculation by the logging engineer. The logging engineer noted that the SGLS probe was warm to the touch after the second logging run. Before logging continued, the borehole air temperatures were measured and the probe was examined. It was several days before the logging resumed, which resulted in the miscalculation.

An analysis of the shape factors associated with applicable segments of the spectra was performed. Comments on the interpretation of the shape factor results are presented in the Tank Summary Data Report for tank A-104.